CHAPTER 3

AFFECTED ENVIRONMENT

3.0 INTRODUCTION

The Affected Environment chapter of this environmental assessment (EA) for the proposed Cow Creek coalbed methane project discusses environmental, social, and economic factors as they currently exist within the Cow Creek Pod project area (CCPA). The material presented here has been guided by management issues identified by the Bureau of Land Management (BLM), Rawlins Field Office (RFO); public scoping; and by interdisciplinary field analysis of the area.

This proposal could potentially affect critical elements of the human environment as listed in BLM's National Environmental Policy Act (NEPA) Handbook H-1790-1 (USDI-BLM 1988b). The critical elements of the human environment, their status in the CCPA and their potential to be affected by the proposed project are listed in Table 3-1.

Table 3-1. Critical Elements of the Human Environment[1], Cow Creek Pod Coalbed Methane Project, Carbon County, Wyoming.

Element	Status on the CCPA	Addressed in text of EA
Air quality	Potentially affected	Yes
Areas of critical environmental concern	None present	No
Cultural resources	Potentially affected	Yes
Environmental justice	Potentially affected	Yes
Prime or unique farmlands	None present	No
Floodplains	None present	No
Native American religious concerns	Potentially affected	Yes
Noxious weeds	Potentially affected	Yes
Threatened and endangered species	Potentially affected	Yes
Hazardous or solid wastes	Potentially affected	Yes
Water quality (surface and ground water)	Potentially affected	Yes
Wetlands/riparian zones	Potentially affected	Yes
Wild and scenic rivers	None present	No
Wilderness	None present	No

[1] As listed in BLM National Environmental Policy Act Handbook H-1790-1 (BLM 1988b) and subsequent Executive Orders

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In addition to the critical elements, this EA discusses potential effects of the project on range resources, transportation, geology/minerals/paleontology, soils, fisheries, vegetation, wildlife, special status species, visual resources, noise, recreation, socioeconomics, and health and safety.

3.1 GEOLOGY/PALEONTOLOGY

3.1.1 Geology

3.1.1.1 Regional Geologic Overview

The SDPA occupies the southeastern portion of the Greater Green River Basin, a large intermontane structural and topographic basin that is part of the Wyoming Basin Physiographic Province. The Greater Green River Basin began developing about 70 million years ago and filled with sediments eroded from surrounding highlands and mountains during the late Cretaceous and early Tertiary Periods.

The SDPA lies along the eastern edge of the Washakie Basin, at the junction with the Sierra Madre Uplift and is underlain at the surface by the Lewis Shale of Late Cretaceous age. The Lewis Shale consists of a thick sequence of shale, siltstone and sandstone that accumulated in deltaic, interdeltaic, and marginal marine environments in a shallow epicontinental sea that extended northward from the Gulf of Mexico to the Arctic Ocean in the Maestrichthian (Winn et al. 1985a, 1985b, 1985c).

By Latest Cretaceous time this seaway had retreated eastward and the marine deposits of the Lewis Shale was replaced progressively upward by beach and estuarine and continental deposits of the Fox Hills Sandstone and Lance Formation respectively that spread westward in response to the Sevier and Laramide orogenies. The Laramide orogeny, resulted locally in the uplift of the Sierra Madre and the subsidence of the Washakie Basin. The latter was filled with Tertiary deposits of the Fort Union and Wasatch Formations during Paleocene and Eocene time, respectively.

In places along the modern Muddy Creek and Cow Creek and atop modern terraces and buttes, the Lewis Shale is overlain by a thin veneer of much younger, unconsolidated sediments of Quaternary age. These sediments include alluvium, colluvium, stream terrace gravels, and wind-blown sand that are late Pleistocene to Holocene in age.

Late Cretaceous rocks at the surface and underlying the SDPA consist of a complex sequence of sedimentary units, including sandstone, shale, coal, and carbonaceous shale. They were predominantly shed from the Sevier orogenic belt to the west and deposited along the western edge of the interior Cretaceous sea (Roehler 1990). Deposition occurred predominantly during two major transgression-regression periods of the sea.

Underlying the Lewis Shale in the SDPA is the Mesaverde Group which contains abundant carbonaceous shale and coal. The Mesaverde Group, which outcrops along the western slope of the Sierra Madre Uplift, is more than 2,500 feet thick. Resistant sandstone beds of the Mesaverde Group form the Atlantic Rim escarpment located immediately north of the project area. The Mesaverde Group is overlain by the Lewis Shale and the Lance Formation in the western portion of the SDPA.

Numerous thin coal seams are present in the upper Almond Formation, a member of the Mesaverde Group. These coal beds are targeted as having the greatest potential for CBM production. The lateral continuity of the Almond coal seams is variable (Hamilton 1993). Geophysical logs of CBM test wells within the CCPA indicate that the Almond coal beds are somewhat discontinuous laterally, however, data for coal seam correlation is limited.

Late Cretaceous and younger surface rocks are underlain by Phanerozoic sedimentary rock that ranges from Cretaceous to Cambrian in age. The Phanerozoic sediments are underlain by Precambrian metamorphic bedrock that comprises part of the ancient North American cratonic shield.

3.1.1.2 Mineral Resources

The three primary mineral commodities in Carbon County are coal, natural gas, and oil (Hoffman and Nunley 2000). All three occur in the CCPA, although coal mining has been of least significance to date. Additional mineral resources occurring within the CCPA include uranium, construction aggregate, and geothermal resources.

Coal reserves in the Greater Green River Basin have been estimated at nearly 1,300 trillion tons (Scott et al. 1995). In the Washakie Basin, coal occurs in the Mesaverde Group and the Fort Union Formation. Within the CCPA, coal primarily occurs within the Almond Formation of the upper Mesaverde. It is sub-bituminous to high-volatile C bituminous in rank (Tyler et al. 1995). Coincident with the Fort Union and Mesaverde coal seams of the Washakie Basin are significant quantities of CBM. Scott (et al. 1994) estimate total reserves in the Greater Green River Basin at approximately 300 trillion cubic feet. Two CBM fields have been explored for CBM resources in the eastern Washakie Basin; the Dixon Field (T12N, R90W), and the Cow Creek Field (T16N, R92W), both of which target Mesaverde coal seams.

3.1.1.3 Geologic Hazards

Potential geologic hazards include landslides, subsidence, and known or suspected active faults. Landslide potential is greatest in areas where steep slopes occur, particularly where the geologic dip of rock formations is steep and parallel to slope, or where erosional undercutting may occur. Landslides occur east of the project area in steeper regions of the Sierra Madre but none have been mapped in the project area (Case et al. 1991). Slope gradients are mild to steep in the area and are steepest along Muddy Mountain, Browns Hill, Ketchum Buttes, Cow Creek Butte, and Wild Horse Butte. Although not specifically mapped, unstable soils in these steep areas may be susceptible to slumping, sliding, and soil creep. Generally, slope gradients within the CCPA are best described as mild.

3.1.2 Paleontology

Paleontologic resources include the remains or traces of any prehistoric organism which has been preserved by natural processes in the Earth's crust (BLM Information Bulletin WY-93-371). Energy minerals such as coal, oil shale, lignite, bitumen, asphaltum, and tar sands, as well as some industrial minerals such as phosphate, limestone, diatomaceous earth, and coquina, while of biologic origin are not considered fossils in themselves. However, fossils of scientific interest may occur within or in association with such materials. Fossils of scientific interest include those of particular interest to professional paleontologists and educators. Vertebrate fossils are always

considered to be of scientific interest. Other kinds of fossils may be placed in this category by the State Director, and field managers, in consultation with BLM staff paleontologists or other expertise.

Paleontologic resources within sedimentary deposits in the project area record the history of animal and plant life in Wyoming during the Late Cretaceous- the time represented by the Lewis Shale. The Lewis Shale is known to yield scientifically significant vertebrate fossils in several areas of Wyoming, but no specific localities have been reported from the SDPA. Fossils known from the Lewis comprises a large and varied marine invertebrate fauna, including many genera of bivalves, baculites, scaphites, and ammonites (Gill et al. 1970) and isurid shark teeth (Breithaupt 1985). Although significant fossils are known from the Lewis Shale from some areas of Wyoming so the formation satisfies BLM Condition 2, which may require additional consideration, the potential for discovery of scientifically significant fossils in the SDPA is consider to be moderate to low, when compared to other Late Cretaceous age formations of Wyoming.

3.2 CLIMATE AND AIR QUALITY

3.2.1 Climate

The CCPA is located in a semiarid (dry and cold), mid-continental climate regime. The area is typified by dry, windy conditions, with limited rainfall and long, cold winters. The nearest meteorological measurements were collected at Baggs, Wyoming (1979-present), approximately 20 miles southwest of the project area at an elevation of 6,240 feet (WRCC 2001).

The annual average total precipitation at Baggs is 11.20 inches, ranging from 18.5 inches (1983) to 4.63 inches (1989). Precipitation is evenly distributed throughout the year, with minor peaks in May, July, and October. An average of 41.3 inches of snow falls during the year (annual high 104.0 inches in 1983), with December and January the snowiest months. In the project area, annual average precipitation is about 8 to 9 inches, based on local BLM precipitation information and NCRS range site descriptions.

Temperatures are generally cooler, frost-free periods shorter, and both precipitation and snowfall greater at higher elevations. The region is typically cool, with average daily temperatures ranging between 5 °F (low) and 33 °F (high) in mid winter and between 48 °F (low) and 86 °F (high) in mid summer. Extreme temperatures have ranged from –50 °F to 100 °F (both occurring in 1984). The frost-free period (at 32 °F) generally occurs from mid-May to mid-September.

The project area is subject to strong and gusty winds, reflecting channeling and mountain valley flows due to complex terrain. During the winter months strong winds are often accompanied by snow, producing blizzard conditions and drifting snow. The closest comprehensive wind measurements are collected at the Rawlins, Wyoming airport nearly 60 miles north-northeast of the project area. However, hourly wind data measurements for December 1994 through November 1995 were collected near Baggs, Wyoming during the Mount Zirkel Wilderness Area Visibility Study. Winds originate from the south to southwest nearly 37 percent of the time. The annual mean wind speed is nearly 10 mph.

The frequency and strength of the winds greatly affects the dispersion and transport of air pollutants. Because of the strong winds in the project area, the potential for atmospheric dispersion is relatively high (although nighttime cooling will enhance stable air, inhibiting air pollutant mixing

and transport). Dispersion conditions will be the greatest to the north and along the ridge and mountain tops.

Mean annual lake evaporation is 50 inches (Martner 1986). The average annual precipitation is 11 inches. This results in a net annual evaporation rate of 39 inches. These meteorological and climatological characteristics of the project area combine to produce a predominantly dry climate where evaporation exceeds precipitation.

3.2.2 Air Quality

Although specific air quality monitoring is not conducted throughout project area, air quality conditions are likely to be very good, as characterized by limited air pollution emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated ranches) and good atmospheric dispersion conditions, resulting in relatively low air pollutant concentrations.

The Wyoming and National Ambient Air Quality Standards set absolute upper limits for specific air pollutant concentrations at all locations where the public has access. The New Source Review-Prevention of Significant Deterioration (PSD) Program is designed to limit the incremental increase of specific air pollutant concentrations above a legally defined "baseline" level (depending on the location's classification). Incremental increases in PSD Class I areas are strictly limited, while increases allowed in Class II areas are less strict. The CCPA and the surrounding areas are classified as PSD Class II. Four PSD Class I areas, the Bridger, Fitzpatrick, Mount Zirkel, and Rawah Wilderness Areas, exist in the region and could be impacted by cumulative project source emissions.

All NEPA analysis comparisons to the PSD Class I and II increments are intended to evaluate a "threshold of concern," and do not represent a regulatory "PSD Increment Consumption Analysis." The determination of PSD increment consumption is an air quality regulatory agency responsibility (with EPA oversight). Such an analysis would be conducted as part of a major New Source Review, including a Federal Land Management Agency's evaluation of potential impacts to Air Quality Related Values (AQRV) such as visibility, aquatic ecosystems, flora, fauna, etc. A "PSD Increment Consumption Analysis" may also be performed by the responsible air quality regulatory agency (or by EPA) in order to determine minor source increment consumption.

While no criteria air pollutant concentration monitoring has occurred in the project area, background values measured in the region are well below established standards. Measured air pollutants include: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone, particulate matter less than 10 microns in effective diameter (PM-10), and sulfur dioxide (SO_2). Assumed background air pollutant concentrations, applicable Wyoming and National Ambient Air Quality Standards, and PSD Class I and II increments (measured in micrograms per cubic meter, or $\mu g/m^3$) are provided in Table 3-2.

The background concentration data were provided by the Wyoming Department of Environmental Quality, Air Quality Division (WDEQ-AQD1997) and Colorado Department of Public Health and Environment, Air Pollutant Control Division (CDPHE-APCD; 1996). These values reflect the most recently available air quality monitoring data collected in the vicinity of the CCPA. An estimate of background air quality concentrations is needed to combine with modeled project-related air quality impacts and to compare the total predicted impacts with applicable air quality standards. It is

Table 3-2. Air Pollutant Background Concentrations, State and Federal Ambient Air Quality Standards, and PSD Increments (ug/m^3)

Pollutant/Averaging Time	Measured Background Concentration	State and National Ambient Air Quality Standards	Incremental Increase Above Legal Baseline PSD Class I	Incremental Increase Above Legal Baseline PSD Class II
Carbon Monoxide (CO)				
1-hour	2,299 a	40,000	n/a	n/a
8-hour	1,148 a	10,000	n/a	n/a
Nitrogen Dioxide (NO_2)				
Annual	10 b	100	2.5	25
Ozone				
1-hour	117 c	235	n/a	n/a
Particulate Matter (PM-10)				
24-hour	20 c	150	8	30
Annual	12 c	50	4	17
Sulfur Dioxide (SO_2)				
3-hour (National)	29 e	1,300	25	512
24-hour (National)	18 e	365	5	91
24-hour (Wyoming)	18 e	260	n/a	n/a
Annual (National)	5 e	80	2	20
Annual (Wyoming)	5 e	60	n/a	n/a

Note: Measured background ozone concentration data is top tenth percentile maximum 1-hour value; other short-term background concentrations are second-maximum measured values.
n/a not applicable
Wyoming Ambient Standards from: Wyoming Air Quality Standards and Regulations, Chapter 2– Ambient Standards
National Ambient Standards from: 40 CFR Part 50
PSD Increments from: 40 CFR Parts 51 and 52 Prevention of Significant Deterioration for Particulate Matter, EPA Final Rule. Federal Register Vol. 58, No. 105, Thursday, June 3, 1993.

Background Air Quality Data Sources:

a Data collected at Rifle and Mack, Colorado, in conjunction with proposed oil shale development during early 1980's (CDPHE-APCD 1996).

b To supplement monitored NO_2 data, separate NO2 modeling analysis was performed, including many oxides of nitrogen (NOx) emission sources (USDI-BLM 1996).

c Data collected UCG Project, 9 miles west of Rawlins, Wyoming, June 1994 – November 1994 (WDEQ-AQD 1997).

d Data collected at Chevron Chemical Company Phosphate Project, 4.5 miles southeast of Rock Springs, Wyoming, 1984 (Cote' 1984).

e Data collected at Craig Power Plant site and at Colorado oil shale areas (CDPHE-APCD 1996).

important that each pollutant's background concentration, model predictions, and air quality standards are all based on the same averaging times.

Continuous visibility-related optical background data were collected at the PSD Class I Bridger Wilderness Area in Wyoming and the PSD Class I Rocky Mountain National Park (just south of the PSD Class I Rawah Wilderness Area) in Colorado, as part of the Interagency Monitoring of

PROtected Visual Environments (IMPROVE) program. Visibility in the Central Rocky Mountains is very good (averaging over 70 miles Standard Visual Range), with fine particle impacts accounting for nearly half of the average degradation (Sisler 1996). In addition, background atmospheric deposition (acid rain) impacts were monitored at the National Acid Deposition Program/National Trends Network sampling station near Pinedale, Wyoming, and site-specific lake chemistry (pH, acid neutralizing capacity, elemental concentrations, etc.) background data have been collected by the U.S. Geological Survey (Water Quality Division) in several high mountain lakes in the nearby wilderness area.

The WDEQ-AQD is the primary air quality regulatory agency responsible (under their EPA approved State Implementation Plan) for determining potential impacts once detailed development plans have been made, subject to applicable air quality laws, regulations, standards, control measures and management practices. Therefore, the State of Wyoming has the ultimate responsibility for reviewing and permitting CCPA air pollutant emission sources before they become operational. Unlike the conceptual "reasonable, but conservative" engineering designs used in this NEPA analysis, the WDEQ-AQD air quality preconstruction permitting would be based on very site-specific, detailed engineering values, available as part of the permit application.

3.3 SOILS

The soils in this portion of Carbon County were studied and mapped to an Order 3 scale by the BLM in 1979 and 1980. This survey covers the proposed project area. Natural Resource Conservation Service (NRCS) mapping is available in this portion of Carbon County on a contracted basis of agricultural lands. No lands within the proposed project area were generally part of any NRCS mapping. Only BLM information was utilized.

The soil survey for the CCPA was initially divided into two tasks: (1) verify existing Order 3 mapping units where existing mapping was available, and (2) gather soil samples on proposed surface disposal areas for laboratory analyses. The primary purpose was to verify existing soil series and to determine the reclamation potential of each series, as mapped. However, based on the decision to not utilize surface disposal of produced water, Task 2 was deleted.

Soil series within the survey area were verified according to previously established information, i.e., previously established soil series or mapping units, wherever possible.

The predominant map units in the CCPA were Absher-Forelle complex and Rallod-Abston-Pinellie complex. Absher-Forelle complex is on nearly level and gently sloping footslopes and alluvial fans. Slopes are smooth. Rallad-Abston-Pinelliis is on underlying to hilly residual uplands on shale bedrock. Slopes are predominantly convex with concave slopes along drainageways. Most have aridic moisture regimes and frigid temperature regimes. In other words, climates are usually dry and cold. According to established range site descriptions for the associated soil series descriptions, 10-14 inches of rainfall occur during the year, with an average air temperature of 35-40 degrees Fahrenheit.

Plant growth begins about April 15 and continues to about July 15. Fall growth will usually occur if moisture is available. Because of the high, dry air, nighttime radiation cooling can produce freezing temperatures any month of the year. The climax plant community is characterized by plants with high tolerance to salt and capable of withstanding drought conditions. The potential plant communities on the Absher and Rallod soils are mainly western wheatgrass, bottlebrush

squirreltail, Indian ricegrass, and Gardner saltbrush. The vegetation of this area is a mixture of 55% grasses and grass-like plants, 5% forbs, and 40% woody plants.

The Absher-Forelle complex map unit is 50% Absher silty clay and 30% Forelle loam. The Rallod-Abston-Pinelli complex map unit is 40% Rallod clay, 25% Abston clay and 20% Pinelli loam. In general, the soils in this area may be light or dark colored and usually exceed 20 inches in depth. The topsoil is high in exchangeable salt and/or sodium. Internal water movement and permeability is slow to moderate. Soil genesis classification of the majority of soils within this area are haplargids, torriorthents, camborthids, natrargids, and torrifluvents.

Runoff is medium to rapid and the hazard of water erosion is moderate to severe. The hazard of soil blowing is moderate. In addition to these physical limitations of the soils in many areas, chemical limitations exist primarily in terms of salinity or sodium affected soils.

A list of the BLM map units found in and adjacent to the CCPA is presented in Table 3-3.

Table 3-3. BLM Map Units Found in and Adjacent to the CCPA

Mapping Unit Number	Mapping Unit Description
225	Cushool-Rock River sandy loams, 3-10%
232	Blazon-Delphill-Diamondville complex, 6-30%
234	Rock River-Ryark-Cushool complex, 3-15%
237	Seaverson-Blazon complex, 3-15%
247	Cushool-Diamondville-Worfman complex, 3-15%
273	Elk Mountain-Yamac Variant sandy loams, 0-15%
289	Absher-Forelle complex, 1-6%
295	Rallod-Abston-Pinelli complex, 2-25%
333S	Laclede alkali-Laclede complex, 0-3%
449	Dines-Dines overflow complex, 0-2%

3.4 WATER RESOURCES

Water resources in the project area include both surface water and groundwater. Surface waters include the Little Snake River (perennial), Muddy Creek (intermittent-ephemeral downstream of the project area and perennial upstream), Dry Cow Creek (ephemeral) and several unnamed ephemeral channels and man-made ponds. Groundwater resources include free water contained within relatively shallow aquifers that are or could be utilized for culinary, agricultural, and/or industrial purposes. The occurrence and distribution of water resources in the project area are dependent on climate, soils, and structural geology.

3.4.1 Surface Water

3.4.1.1 Quantity

The project area is located within the Little Snake River drainage basin. An unnamed tributary to Dry Cow Creek, an ephemeral tributary to Muddy Creek, is found within the project area. Muddy Creek is an intermittent to ephemeral stream that carries water most of the year to its confluence with the Little Snake River near Baggs. Dry Cow Creek has for some time received water from a non-hydrocarbon producing oil well (1X-12), which produced 180,600 gallons of water per day from a casing leak. This water was the source of supply for the Little Snake River Conservation District (LSRCD) Reservoir located in the NW 1/4 of Section 13, T16N:R92W and was constructed by the LSRCD, BLM and Game & Fish in 1997 to supply water for use by stock and wildlife by containing the water discharged from the Double Eagle 1X-12 well. The channel immediately below the dam at this reservoir is moist and can contain small pools of water. This is not a flowing condition and is attributed to seepage from the dam outlet structure.

The Little Snake River drains the largest basin in the Yampa River basin (Driver et al. 1984). It joins the Yampa River in northwest Colorado. The Yampa River flows southwest to its confluence with the Green River in Utah. The Green River drains to the Colorado River, which drains to the Pacific Ocean.

Annual peak flows for all streams within the project area generally occur in late May through early June in response to snowmelt. Baseflows are reached in the fall and continue through March until low elevation snowmelt initiates the rising limb of the hydrograph. A United States Geological Survey (USGS) continuous gaging station on the Little Snake River near Dixon recorded a maximum peak discharge of approximately 13,000 cfs on May 16, 1984, while minimum flows of near 0 cfs occur in late summer and early fall at the end of the irrigation season (Druse et al. 1994).

The channel reach above the LSRCD reservoir is well-vegetated and stable, having received discharge water from the 1X-12 well for several years. The natural character of this reach is ephemeral; in no way should it be characterized as perennial. The channel reach immediately below the LSRCD reservoir is moist and can contain small pools of water. This condition is attributed to seepage from the dam outlet structure. It is not a flowing condition.

3.4.1.2 Quality

There are six USGS surface water quality stations in and around the project area, including two on the Little Snake River, two on Muddy Creek, and one each on Cow Creek and Dry Cow Creek. Average sample data from each of the stations are shown on Table 3-4. The data suggest that surface waters in the project area are of moderately high pH (8.1 to 9.2) and moderately dissolved oxygen (9 to 11 mg/l). Constituents not shown had no analyses available.

Generalizations among other sample parameters are made difficult by high variability between stations. Trends become apparent, however, when the stations are divided according to the surface water designation. Table 3-5 averages select parameters from Table 3-4 into ephemeral, intermittent, and perennial classes.

Water quality in ephemeral streams is represented by the Cow Creek and Dry Cow Creek monitoring stations. The ephemeral quality is characterized by high TDS (1,620 mg/l) and sodium

and bicarbonate dominance as the major dissolved ions. Sodium dominance is reflected in the

relatively high sodium adsorption ratio (SAR) of 14.1.

The two Muddy Creek monitoring stations represent intermittent surface water quality. Muddy Creek has actually been classified as an intermittent to perennial stream (Higley 1996), but its classification has been simplified for Table 3-5. Intermittent streams in the project area are characterized by moderate TDS (772 mg/l) and the replacement of bicarbonate by sulfate as the major anionic species. Sodium dominance is reflected in the SAR of 6.1, but is less marked than in ephemeral flows.

Table 3-4. Surface Water Quality in the Project Area

	USGS Surface Water Quality Station[1]					
	Cow Creek	**Dry Cow Creek**	**Muddy Creek**	**Muddy Creek**	**Little Snake River**	**Little Snake River**
Station Number	09115080	09258200	09258900	09259000	09257000	09259050
Sample Period	1978-1979	1975-1980	1976-1978	1957-1991	1957-1988	1980-1997
Number of Samples[2]	20	9	3	41	107	100
pH, standard units	9.2	8.6	8.6	8.2	8.1	8.1
Conductance, mmhos/cm	2925	2162	1350	966	259	366
Total Dissolved Solids[3]	1801	1438[4]	913	630[4]	158	243
Suspended Solids	133	1111	6198	3191	154	228
Turbidity	284 NTU	1013 JTU	1260 NTU	NM[5]	13 JTU	167 NTU
Hardness as $CaCO_3$	174	37	315	270	111	151
Oxygen	9	11	11	10	9	10
Sodium	560	98	200	286	11	26
Calcium	19	9	54	42	30	34
Magnesium	31	4	44	40	8	12
Potassium	11	4	7	9	2	2
Bicarbonate	870	170	373	308	159	190
Carbonate	186	4	0.5	NM	0	1
Sulfate	181	65	380	320	25	54
Chloride	132	21	65	32	3	2
Fecal coliform, #/100 ml	535	NM	NM	8	NM	351

[1] Data available on the Internet at http://www.wrds.uwyo.edu
[2] Total number of grab samples analyzed; not every parameter was analyzed in every sample
[3] All units are mg/l except as noted
[4] TDS calculated from specific conductance due to lack of sample data
[5] NM = not measured

Two Little Snake River stations monitor perennial water quality in the project area. Perennial quality is characterized by a significantly reduced TDS (201 mg/l) from intermittent and ephemeral streams. Sodium is also displaced by calcium as the major cationic species. This is reflected in the low SAR (0.7 mg/l).

The WDEQ classifies Wyoming streams according to quality and degree of protection. Four

classes have been identified as follows (WDEQ 2001):

Class 1: Those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled through implementation of appropriate best management practices. Considerations employed during the designation of these waters include water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archaeological, fish and wildlife, the presence of significant quantities of developable water and other values of present and future benefit to the people.

Table 3-5. Surface Water Quality Comparison

	Stream Class		
	Ephemeral	**Intermittent**	**Perennial**
Representative Surface Waters	Cow Creek and Dry Cow Creek	Muddy Creek	Little Snake River
Total Dissolved Solids[1]	1,620	772	201
Sodium	329	243	19
Calcium	18	42	10
Magnesium	14	48	32
Potassium	8	8	2
Bicarbonate	520	341	175
Carbonate	95	0.5	0.5
Sulfate	123	350	40
Chloride	77	49	3
SAR	14.1	6.1	0.7

[1] All units are mg/l except SAR, which is unitless

Class 2: Surface water other than Class 1 determined to be presently supporting game fish, have the hydrologic and natural water quality potential to support game fish, or include nursery areas or food sources for game fish.

Class 3: Those surface waters, other than those classified as Class 1, which are determined to be presently supporting nongame fish only, have the hydrologic and natural water quality potential to support nongame fish only, or include nursery areas or food sources for nongame fish only.

Class 4: Those surface waters, other than those classified as Class 1, which are determined to not have the hydrologic or natural water quality potential to support fish and include all intermittent and ephemeral streams.

Dry Cow Creek has been classified as a Class 4 stream. Cow Creek is classified as a Class 3 stream. The Little Snake River and Muddy Creek are designated Class 2. The portion of the Little Snake River below Baggs has been further classified as a secondary body contact recreation water. This classification adds fecal coliform restrictions normally reserved for Class 1 water

bodies.

3.4.1.3 Waters of the U.S.

Most of the surface water features in the project area qualify as Waters of the United States. Waters of the U.S. include territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams); special aquatic sites and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are waters of the U.S. (EPA 33 CFR § 328.3(a)). Such areas are regulated by the EPA and COE. Many of the drainage channels identified on the USGS topographic maps are vegetated swales which are not considered to be waters of the U.S. by the COE. Any activity that involves discharge of dredge or fill material into or excavation of such areas is subject to regulation by the COE pursuant to Section 404 of the CWA. Activities that modify the morphology of stream channels are also subject to regulation by the SEO of Wyoming. Special aquatic sites and wetlands are discussed in greater detail in the Vegetation Section 3.5.

3.4.2 Groundwater

The project area occurs in the Colorado Plateau and Wyoming Basin groundwater regions described by Heath (1984); the Upper Colorado River Basin groundwater region described by Freethey (1987); or Washakie Basin described by Collentine et al. (1981) and Welder and McGreevy (1966). Groundwater resources include deep and shallow, confined and unconfined aquifers. Site-specific groundwater data for the project area are limited. Existing information comes primarily from oil and gas well records from the WOGCC, water-well records from the Wyoming SEO, and from the USGS (Weigel 1987). Regional aquifer systems pertinent to the project area are discussed by Heath (1984), Freethey (1987), and Driver et al. (1984). Basin-wide evaluations of hydrogeology specific to the project area have been investigated by Collentine et al. (1981). The most relevant hydrogeologic study specific to the project area is by Welder and McGreevy (1966).

3.4.2.1 Location and Quantity

Groundwater in the Washakie Basin is generally found in artesian aquifers, although it is also present in unconfined alluvial valleys and in isolated, saturated outcrops (Welder and McGreevy, 1966). Site-specific hydrologic parameters would be generated once the project wells are drilled, completed and tested. Table 3-6 summarizes the water-bearing characteristics of the geologic formations present in the project vicinity. Hydraulic conductivity is shown in the table as permeability. Of the geologic units listed in the table, Welder and McGreevy (1966) suggest that those capable of producing the greatest quantity of water include the following: Quaternary alluvium; Tertiary deposits in the Browns Park, Wasatch, and Fort Union formations;
Cretaceous formations, including Mesaverde, Frontier, and Cloverly; the Sundance-Nugget

Sandstone of the Jurassic Age; and the Tensleep and Madison formations of the Paleozoic Era. Following is a brief description of the major aquifers of the project area.

Table 3-6. Water-Bearing Characteristics of Geologic Formations in the Washakie Basin[1]

Era	Period	Geologic Unit	Thickness	Hydrologic Properties		
				Well Yield (gpm)	Transmissivity (gpd/ft)	Permeability (gpd/ft^2)
Cenzoic	Quaternary		0-70	<30	168-560	21-62
	Tertiary	Browns Park Fm.	0-1,200	3-30	100-10,000	NM
		Wasatch Fm.	0-4,000+	30-50	150-10,000	0.04-18.2
		Fort Union Fm.	0-2,700+	3-300	<2,500	<1
Mesozoic	Upper Cretaceous	Lance Fm.	0-4,500+	<25	<20	0.007-8.2
		Fox Hill Sandstone	0-400	NM	10-20	0.9
		Lewis Shale	0-2,700+	2-25[2]	0.03-50	0.002-0.9
		Almond Fm.[3] (Mesaverde Group)	0-600	NM	2,000-8,000	100-800
		Mesaverde Group (excl. Almond Fm.)	300-2,800	<100	<3,000	NM
		Baxter Shale (incl. Steele Shale and Niobrara Fm.)	2,000-5,000+	Major regional aquitard between Mesaverde and Frontier aquifers. Hydrologic data unavailable.		
		Frontier Fm.	190-1,1900+	1-100+	<100-6,500	NM
	Lower Cretaceous	Mowry Shale	150-525	Regional aquitard. Hydrologic data unavailable.		
		Thermopolis Shale (incl. Muddy Sandstone)	20-235	Considered a leaking confining unit. Hydrologic data unavailable.		
		Cloverly Fm.	45-240	25-120	340-1,700	1-177
	Upper Jurassic	Morrison Fm.	170-450+	Confining unit between Cloverly and Sundance-Nugget aquifers. Hydrologic data unavailable.		
		Sundance Fm.	130-450+	27-35	12-3,500	NM
	Lower Jurassic-Upper Triassic	Nugget Sandstone	0-650+	35-200	<2,166	NM
	Triassic	Chugwater Fm.	900-1,500+	Confining unit between Sundance-Nugget and Paleozoic aquifers. Hydrologic data unavailable.		
Mesozoic-Paleozoic	Lower Trassic Permian	Phosphoria Fm. (incl. Goose Egg Fm.)	170-460	Probable poor water-bearing capabilities due to low permeability. Hydrologic data unavailable.		
Paleozoic	Permian-Pennsylvanian	Tensleep Fm.	0-840+	24-400	1-374	NM
	Lower and Middle Pennsylvanian	Amsden Fm.	2-260+	Probable poor water-bearing capabilities due to predominance of fine-grained sediments.		
	Mississippian	Madison Limestone	5-325+	<400	Variable	NM
Paleozoic	Cambrian	Indef. rocks	0-800+	4-250	NM	NM
Precam-brian	N/A	Igneous and metamorphic rocks	Unknown	10-20	1<1,000	Generally high in upper 200 ft of unit

[1] Adapted from Table V-1 in Collentine et al. (1981). Formations not encountered in project area have been omitted.
[2] From well completion records on file with SEO
[3] From Atlantic Rim CBM well test data

Quaternary aquifers in the Washakie Basin are comprised of alluvial deposits along major floodplains and isolated windblown and lake sediments. The major Quaternary aquifers in the vicinity of the project area occur in alluvial deposits along the Little Snake River and Muddy Creek,

and in windblown segments along the Sand Hills. Groundwater flow within the sandy Quaternary aquifers is typically downward toward permeable underlying formations (Collentine et al. 1981).

Tertiary aquifers in and near the project area occur in the Browns Park Formation along the Little Snake River flood plain and adjacent to the Sierra Madre Uplift, the Fort Union Formation near the Muddy Creek flood plain to the west, and isolated Wasatch Formation outcrops near the center of the project area. Groundwater generally flows west-southwest from the higher elevations along the Sierra Madre Uplift toward the low-lying Washakie Basin center and the major streams (Collentine et al. 1981).

Cretaceous aquifers in the project area occur in three major geologic formations. From youngest to oldest they are the Almond Formation of the Mesaverde Group, the Frontier Formation, and the Cloverly Formation. The Mesaverde is exposed along the eastern slopes of the project area, although a mantle of Tertiary deposits unconformably overlies large areas of the Late Cretaceous strata. No outcrops of the Frontier or Cloverly formations are present within the project area.

The Cretaceous aquifers are composed of interbedded sandstone, shale, and coal and have demonstrated considerable yields in existing wells (Collentine et al. 1981). Recharge to these water-bearing strata is principally from precipitation infiltration and the movement of groundwater from the overlying Tertiary sediments at their outcrops and subcrops along the elevated eastern margin of the Washakie Basin. Regional groundwater flow direction is toward the west in response to the structural dip and surface topography. The Almond Formation coal seams, which are the targeted reservoir for the CCPA, are classified as confined to semi-confined aquifers because they are bound by impervious to semi-pervious layers of shale and siltstone. CBM test wells completed in the Almond Formation coal seams located within the project area exhibit shut-in hydrostatic pressures indicative of flowing artesian conditions. Based on existing hydrogeologic information, groundwater in the Almond Formation coal seams at the completions depths in the existing CBM wells is hydraulically isolated from shallow groundwater and surface water resources. This supports the potential for groundwater discharge in the form of springs along the eastern margin of the Washakie Basin. In fact, the Mesaverde Group is a source of many springs along the Atlantic Rim and flowing wells can probably be obtained by completing wells in the Mesaverde.

Separated from the Cretaceous aquifers by the impermeable Morrison Formation is the Sundance-Nugget Aquifer of the Jurassic Age. The Sundance-Nugget aquifer is comprised of permeable sandstone with minor quantities of shale, siltstone, and limestone (Collentine et al. 1981). The flow characteristics of the Sundance-Nugget aquifer are not well defined.

The final two major aquifers occur in Paleozoic Era rocks. The Tensleep Formation from the Pennsylvania Age consists of fine- to medium-grained sandstone between confining layers of the Chugwater Formation (Triassic) and the Amsden Formation (Pennsylvanian) (Collentine et al. 1981). The Madison aquifer is comprised of limestone and dolomite bordered on the top by the fine-grained Amsden sediments and on the bottom by Cambrian rocks. Wells completed within both of these Paleozoic aquifers have demonstrated yields up to 400 gpm. Groundwater flow is west-southwest in the project area.

Driver et al. (1984) suggest that the Browns Park Formation would be the best candidate for large-scale groundwater development. Recharge to the aquifers is generally by precipitation and surface water seepage percolating through permeable overlying materials (Welder and McGreevy 1966).

An SEO records review revealed 63 permitted wells in the vicinity of the project area. They are apportioned as follows: 2 domestic, 4 domestic/stock, 20 stock, 1 stock/irrigation, 2 stock/miscellaneous, 1 municipality, 32 miscellaneous/monitoring, and 1 miscellaneous use. Of the 63 permitted wells, 30 reported positive yields. Geologic units and yields of the 30 wells are listed in Table 3-7. The majority of these wells were developed in the Upper Cretaceous age Lance Formation, Lewis Shale and Mesaverde Group, and the Quaternary age Alluvium.

3.4.2.2 Quality

Groundwater quality is related to the depth of the aquifers, flow between aquifers, and the rock type. Groundwater quality is variable in the CCPA. TDS, an indicator of salinity, is generally less than 2,000 mg/l (slightly saline to saline) in the project area, with local concentrations of less than 500 mg/l (considered fresh).

Table 3-7. Existing Groundwater Wells in Project Vicinity

Formation	Number of Wells	Yield[1] (gpm)
Alluvium	5	1.5-20
Browns Park Formation	2	8-25
North Park Formation	2	2-25
Wasatch Formation	2	5-10
Fort Union Formation	2	11.5-20
Lance Formation	4	2-7.5
Lewis Shale	7	1–25
Mesaverde Group	5	2-20
Unknown	1	2

[1] obtained from SEO well completion permits

Because most existing groundwater wells and the proposed CBM wells of the CCPA occur in Mesaverde aquifers, a detailed Mesaverde groundwater quality analysis has been included. Table 3-8 lists the major cation and anion composition of Mesaverde groundwater in the project area. Sodium and bicarbonate dominate as the major ionic species. Collentine et al. (1981) offer three possible explanations for this dominance: (1) exchange of dissolved calcium for sodium; (2) sulfate reduction resulting in bicarbonate generation; and (3) intermixing of sodium-rich, saline water from low-permeability zones within the Mesaverde or adjacent aquifers.

Table 3-8. Major Ion Composition of Mesaverde Groundwater

Cation	Concentration (mg/l)	Anion	Concentration (mg/l)
Sodium	513	Bicarbonate[2]	1,284
Calcium	7	Carbonate[1]	9
Magnesium	3	Chloride	56
Potassium[1]	5	Sulfate	11

[1] potassium and carbonate concentrations were not measured in CBM samples; values represent composite of USGS data for Mesaverde wells in project vicinity (USGS 1980)
[2] bicarbonate was not measured; value shown was calculated from ion balance

Table 3-9 presents a comparison of Mesaverde groundwater with WDEQ suitability standards. The composite results of the three CBM wells analyzed indicate water that is generally suitable for livestock use, but is unsuitable for domestic supply or irrigation without treatment or dilution. Parameters with measured concentrations in excess of Wyoming drinking water standards include iron, manganese, and TDS. Calculated SAR (47.3) and residual sodium carbonate (41 meq/l) exceed the agriculture suitability limits of 8 and 1.25, respectively. Unless the water were mixed with an existing water source of lower sodium and bicarbonate and lower total salinity, irrigation would result in reduction in infiltration in the affected soil.

There is no published data available for the Lewis sands in the project area.

Regional ground-water flow is generally westward into the basin within each aquifer, from recharge areas of aquifer outcrops at higher elevations to the east. If local geologic structures bring these aquifers into outcropping positions downgradient from the respective recharge areas, springs can occur. The confining beds slow the movement of water, and hence, movement of potential contaminants between aquifers. Although there is some downward movement of the water from the surface units, most of the groundwater movement, if any, is upward from the deeper aquifers to the shallower aquifers. It should be noted that ground-water flow occurs at very slow rates, typically a few feet per year. Concerns have been raised for several gas field projects in southwest Wyoming regarding groundwater quality degradation due to the piercing of confining layers and vertical and horizontal migration and mixing of water of variable qualities. Data suggesting this is a current problem in the project area are not available. Improperly completed injection wells could be a potential source of contamination. However, injection wells must pass periodic mechanical integrity tests to assure that cross-flow out of the injection zone in the wellbore does not occur.

3.5 VEGETATION/WETLANDS/NOXIOUS WEEDS

3.5.1 Introduction

The CCPA is located in the sagebrush steppe plant community that is typical of the high inter-mountain desert of south central Wyoming. Vegetation in the CCPA is typical of the semi-arid Wyoming Basin floristic region, where precipitation and soil parent material are controlling factors for plant composition. Vegetation often appears sparse. The primary vegetation cover types in the CCPA, as identified by the Wyoming Gap Analysis Program (GAP, Merrill et al. 1996), are Wyoming big sagebrush, desert shrub, and greasewood. The Wyoming big sagebrush (*Artemisia* spp.) cover type typically consists of more than 25% shrub cover with interspersed mixed grasses. The desert shrub vegetation cover type is often dominated by saltbush (*Atriplex* spp.) but may also contain a large component of greasewood or Wyoming big sagebrush communities. The greasewood (*Sarcobatus remiculatus)* type occurs along the alluvial fons and riparian flats of a tributary drainage of Dry Cow Creek.

3.5.2 Waters of the U.S. Including Special Aquatic Sites and Wetlands

Waters of the U.S. consist of bodies of open water such as lakes and streams as well as special aquatic sites, including jurisdictional wetlands. These are unique and important cover types due to their ecological value and protection under the federal Clean Water Act (CWA). Jurisdictional wetlands and other aquatic habitats merit special concern due to their relative rarity in the region, their functional role in and as components of hydrologic systems, their unique and important wildlife

Table 3-9. Groundwater Quality for Mesaverde Wells in Project Area

Parameter	Concentration[1]	Unit	Groundwater Suitability Standards[2]		
			Domestic	Agriculture	Livestock
Aluminum	0.045	mg/l	---	5	5
Ammonia	0.9	mg/l	0.5	---	---
Arsenic	0.0006	mg/l	0.05	0.1	0.2
Barium	0.36	mg/l	1	---	---
Beryllium	<0.002	mg/l	---	0.1	---
Boron	0.25	mg/l	0.75	0.75	5
Cadmium	<0.0002	mg/l	0.01	0.01	0.05
Chloride	56	mg/l	250	100	2000
Chromium	0.002	mg/l	0.05	0.1	0.05
Cobalt	NM	mg/l	---	0.05	1
Copper	0.03	mg/l	1	0.2	0.5
Cyanide	<5	mg/l	0.2	---	---
Fluoride	1.0	mg/l	1.4 - 2.4	---	---
Hydrogen Sulfide	NM	mg/l	0.05	---	---
Iron	3.06	mg/l	0.3	5	---
Lead	0.004	mg/l	0.05	5	0.1
Lithium	NM	mg/l	---	2.5	---
Manganese	0.102	mg/l	0.05	0.2	---
Mercury	<0.0004	mg/l	0.002	---	0.00005
Nickel	0.041	mg/l	---	0.2	---
Nitrate	<0.03	mg/l	10	---	---
Nitrite	<0.03	mg/l	1	---	10
Oil & Grease[3]	<1	mg/l	Virtually Free	10	10
Phenol	65	mg/l	0.001	---	---
Selenium	<0.005	mg/l	0.01	0.02	0.05
Silver	<0.003	mg/l	0.05	---	---
Sulfate	11	mg/l	250	200	3000
TDS	1,322	mg/l	500	2000	5000
Uranium	NM	mg/l	5	5	5
Vanadium	NM	mg/l	---	0.1	0.1
Zinc	0.3	mg/l	5	2	25
pH	8.2	s.u.	6.5 - 9.0	4.5 - 9.0	6.5 - 8.5
SAR	47.3	<none>	---	8	---
RSC[4]	41	meq/l	---	1.25	---
Radium 226 + Radium 228	0.9	pCi/l	5	5	5
Strontium 90	NM	pCi/l	8	8	8
Gross alpha	NM	pCi/l	15	15	15

1 boron, ammonia, fluoride, and nitrate/nitrite concentrations from 11 Mesaverde groundwater wells (USGS 1980); remaining concentrations from three Mesaverde CBM wells in project area

2 from WDEQ Water Quality Rules and Regulations, Chapter VIII

3 reported as total petroleum hydrocarbons

4 residual sodium carbonate calculated from measured calcium and magnesium concentrations and calculated bicarbonate concentration

habitat and forage value, their heritage value, and their protection and regulation under the CWA. Under the CWA, wetlands are defined as “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil

conditions."

To qualify as a jurisdictional wetland, the area of interest must meet all three of the criteria used to positively determine the existence of a wetland. These include: (1) dominance of hydrophytic plants; (2) presence of hydric soils; and (3) wetland hydrology (i.e., presence of surface or subsurface water) suitable to sustain criteria 1 and 2. Hydrophytic plants are those species which either require or tolerate wet or saturated soils and are therefore indicative of these conditions. A hydric soil is a soil that is saturated, flooded, or ponded with water for a time sufficient to develop anaerobic soil conditions during the growing season (i.e., reduced soil oxygen levels). These soils develop certain characteristics that are indicative of the wet and anaerobic conditions. These conditions may include an undecomposed organic surface layer (histic epipedon), surface horizons with low chromas (i.e., very dark brown to black), organic staining and streaking, grey-colored layers or horizons, iron concretions, and/or light grey- or rust-colored mottles or specks of highly contrasting color, all of which generally occur within 18 inches of the soil's surface. Wetland hydrology is characterized as permanent or periodic inundation or soil saturation for a significant time during the growing season. Wetland hydrology may be supplied by surface water (i.e., streams), groundwater, and/or direct precipitation.

Wet meadows and marshlands of the Great Basin are generally characterized by a very dense (nearly 100 percent) to sparse (10 to 80 percent) vegetative growth. The soils are generally saturated or inundated for a portion of the growing season. Species such as sedges, muskgrasses, saltgrass, spike rushes, water-weeds (*Elodea* spp.), mannagrasses, rushes, stoneworts, pond weeds (*Potamogeton* spp.), three-square, cattail dominate the dense groundcover. Various species of willow as well as cottonwood may also be distributed across this type (Brown 1994).

Within the project area, only one site, the LSRCD reservoir and its inflow and outflow channels have the potential to support marsh/wetland vegetation. The source of the reservoir water is a non-hydrocarbon producing oil well (1X-12 well) that is located approximately ½ mile upstream from the reservoir. This well has yielded flow for many years and the water flow into the inflow channel now supports a well established riparian vegetative community downstream. The remainder of the drainage channels occurring within the project area are ephemeral and only carry water during spring runoff and summer storm events. None of the other channels within the study area exhibit wetland characteristics.

The wetted characteristics of the LSRCD reservoir area are artificial and entirely supported by CBM produced waters. Additionally, the relatively short time span since the reservoir's impoundment in 1997 has limited the extent to which wetland soils and vegetation have developed at this site. Emergent vegetation has not become established in the reservoir. Hydric soils are beginning to develop, although the soil evolution is still incomplete. The impoundment of this CBM produced water has generally dried the channel downstream from the reservoir. Limited seepage from the outflow structure on the dam keeps the channel wetted immediately downstream, with a few isolated pockets of standing water.

3.5.3 Threatened and Endangered Species

One federally endangered plant species, blowout penstemon (*Penstemon haydenii*), has the potential to occur on or near the CCPA according to the USFWS (2000) and the Wyoming Natural Diversity Database (WYNDD 2000). No other threatened or endangered plant species are

expected to occur on the CCPA.

Blowout Penstemon. Blowout penstemon is a member of the snapdragon family. The species is most commonly found in the bowls and along the rims of sandy blowouts (Fertig 2000). In Wyoming, the species has been documented on very steep, unstable sand dunes (Fertig 2001). Within these limited habitats, blowout penstemon typically occurs in large, multi-stemmed clumps. When in bloom, its lavender-purple flowers stand out against other sparse vegetation found in and around sandy blowouts. In addition to features of its leaves and flowers, blowout penstemon's lavender or vanilla-like fragrance is a characteristic that distinguishes it from other *Penstemon* species. Blowout penstemon typically blooms between late May and late June. This short flowering period is the best time of year to survey for the species.

A large area of sand dunes and blowouts exists in and around the Sandhills Area approximately 5 miles northeast of the CCPA. This area may provide potential habitat for blowout penstemon, however, the species was not found during field surveys of this area conducted by the Wyoming Natural Diversity Database in June, 2000 (Fertig 2001). Very small and limited areas of sandy blowouts may occur in the vicinity of the CCPA, however, the closest known population of blowout penstemon is located just south of the Ferris Mountains (Fertig 2000) and blowout penstemon was not found in the Sandhills Area, therefore blowout penstemon is unlikely to occur on the CCPA.

3.5.4 Species of Concern

Species of concern includes candidates for federal listing under the ESA, BLM special status species, FS sensitive species, WGFD special concern species, and species that are designated rare by The Nature Conservancy and WYNDD. Species which are not listed as endangered or threatened by the FWS, but have been identified for possible listing in the future, are classified as candidate species. Eleven plant species of concern may potentially occur within or near the CCPA (WYNDD 2000). Of these, Gibbens penstemon and Crandall's rock-cress have the highest conservation priority (WYNDD 2000). Appendix D provides information on the names, sensitivity status, counties in which these species have been documented, notes on their overall range and distribution within Wyoming, probability of occurrence on the CCPA, and descriptions of habitat types in which these special concern plants are found. Five of the species are unlikely to occur on or near the CCPA because their respective required habitat types do not occur there. The remaining six special concern plant species have low to moderate potential to occur in or near the CCPA.

3.5.5 Invasive/Noxious Weeds

The area which includes the CCPA is vulnerable to infestations of invasive/noxious weeds such as Canada thistle, musk thistle and black henbane. Infestations of invasive/noxious weeds are relatively minimal within the CCPA at present. However, any newly disturbed surface within the CCPA would be susceptible to infestations of invasive/noxious weeds. Monitoring for weed infestations and spraying for two consecutive seasons, after emergence but before seeding, has been an effective method of controlling these species.

3.6 RANGE RESOURCES AND OTHER LAND USES

3.6.1 Range Resources

The CCPA lies within and occupies a portion of the Doty Mountain Grazing Allotment (#0415) which includes approximately 83,368 acres, 71 percent of which is public land. The Doty Mountain Allotment supports 6,974 AUM's (all cattle) and the average stocking rate is about twelve acres per AUM. The season of use extends from April 1 to December 1. The project area lies within the winter pasture of the allotment where livestock use is rotated within a nine pasture system. The winter pasture is used with a low stocking rate of livestock during May, with the principle use period occurring in September through November with a moderate stocking rate of livestock (USDI-BLM 1972, Warren 2000).

3.6.2 Other Land Uses

The CCPA contains approximately 2,050 federally owned acres. There are no State of Wyoming or privately owned acres within the CCPA. Federal lands within the project area are administered by the BLM Rawlins Field Office in accordance with the Great Divide RMP.

Other land uses within and adjacent to the CCPA are agriculture (primarily cattle and sheep grazing), wildlife habitat, oil and natural gas exploration, development, and transmission, and dispersed outdoor recreation (primarily hunting in the fall). No developed recreation facilities exist within or adjacent to the project area. For more information on recreational resources in the project area see Section 3.8.

Right-of-way (ROW) and lease data for the sections were obtained from BLM records. There are five road ROW's and one pipeline ROW currently on record for the CCPA.

3.7 WILDLIFE/FISHERIES

3.7.1 General Wildlife

The CCPA includes approximately 2,050 acres of sagebrush steppe and desert shrub wildlife habitats. Many common species of birds, mammals, amphibians, and reptiles may be found within the project area. The proposed development is not expected to significantly impact the common species found in the CCPA, therefore they are not considered in this analysis. Those species being considered for threatened or endangered status, big game species, raptors, and greater sage grouse are considered in this analysis. The area of analysis for wildlife concerns consists of the area of the Cow Creek Pod plus a two-mile buffer for greater sage grouse leks, and a one-mile buffer for raptor nests. Wildlife surveys discussed and summarized herein were conducted as part of larger scale surveys being performed in preparation of the ARPA EIS.

Information regarding the occurrence of species being considered for threatened or endangered status, big game species, raptors, and greater sage grouse near the CCPA was obtained from several sources. Greater sage grouse lek locations, seasonal big game range designations, raptor nest locations, and locations for threatened and endangered species were obtained from the Wyoming Game and Fish Department's (WGFD) Wildlife Observation System (WOS) and BLM's raptor nest overlays. WGFD big game herd unit annual reports were used for herd unit population statistics. This existing wildlife information for the CCPA was supplemented through survey data

collected by Hayden-Wing Associates (HWA) biologists in 2000 and 2001. These data collections consisted of aerial and ground surveys to: (1) determine occurrence of threatened, endangered, proposed, or candidate species for listing on the pod area; (2) determine the occurrence, location, size, and burrow density of white-tailed prairie dog colonies; (3) determine the location and activity status of raptor nests; (4) search for previously undocumented greater sage grouse leks and determine the activity status of all leks in the area; (5) locate winter greater sage grouse concentration areas; and (6) determine the occurrence, location, and size of mountain plover habitat and conduct a preliminary presence/absence survey for the species.

3.7.2 Big Game

Three big game species: pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and elk (*Cervus elaphus*) occur on or may utilize the CCPA during the course of a year. However, due to low shrub diversity, lack of hiding cover, and proximity to county and BLM improved roads, the CCPA is most often frequented by pronghorn antelope. The types of big game seasonal ranges designated by WGFD which are discussed are winter, winter/yearlong, and crucial winter/yearlong. Winter ranges are used by substantial numbers of animals only during the winter months (December through April). Winter/yearlong ranges are occupied throughout the year but during winter they are used by additional animals that migrate from other seasonal ranges. Crucial big game range (e.g. crucial winter/yearlong range) describes any seasonal range or habitat component that has been documented as a determining factor in a population's ability to maintain itself at a specified level over the long term. Crucial winter ranges are typically used 8 out of 10 winters.

Pronghorn Antelope. The CCPA is located within the 1,394-square-mile Baggs Herd Unit. The CCPA contains pronghorn winter/yearlong range (1,899 acres) and crucial winter yearlong (151 acres; Figure 4-1). The project area lies within the transition area between crucial winter range and terrain to the east which is often unusable in winter. During years with higher snowfall across the winter range, pronghorn congregate on the crucial winter range, resulting in heavy browse use here and only light use of the transition area in the fall and spring. In years with low amounts of snow, the pronghorn are not forced to spend as much time on the crucial winter range. Utilization of important shrub species is then more evenly distributed across this transition area with less use on the plants in the crucial winter range. No major pronghorn migration routes pass through the CCPA (WGFD 2000a). The 1999 post hunt season population estimate for the Baggs Herd Unit was 7,000 animals, which is 24.6 percent higher than the 1994-1998 estimated population average of 5,620. The population objective was increased 25 percent in 1994, from 7,200 to 9,000. Therefore, the current population estimate of 7,000 is 22 percent below the WGFD management objective. According to WGFD (2000a), the Baggs antelope herd had experienced low fawn production resulting in slow growth, but production has improved during recent years and the population appears to be rebounding. The CCPA is located within Hunt Area 53, where the hunter success rate for 1999 was 95.4%.

Mule Deer. The CCPA is located within the Baggs Herd Unit. The Baggs Herd Unit is very large (3,440 square miles) and contains habitats ranging from subalpine and montane coniferous forests to desert scrub. The CCPA contains winter/yearlong mule deer range (1,596 acres) and crucial winter/yearlong range (454 acres). No major mule deer migration routes pass through the CCPA (WGFD 1999a). The 1999 post-hunt population estimate for the Baggs Herd Unit was 18,300. This estimate is slightly below the WGFD management objective of 18,700. The CCPA is located within Hunt Area 82, where the hunter success rate for 1999 was 56%.

Elk. The CCPA is located within the Sierra Madre Herd Unit (2,425 square miles). Most elk in the herd unit utilize spring/summer/fall ranges in the Sierra Madre Mountains, although there are groups using habitats on Atlantic Rim and around McCarty Canyon. During winter, the elk migrate to lower elevation winter range habitats on the west side of the Sierra Madre Mountains and into the Atlantic Rim/Sand Hills areas. Some animals may migrate as far west as the Powder Rim (~ 40 miles west of Baggs; Porter 1999). However, no major elk migration routes pass through the CCPA (WGFD 2000a). The habitat in the CCPA is designated as elk winter range (2,050 acres). The 1999 post hunt season population estimate for the Sierra Madre Herd Unit of 7,300 animals is 73.8 percent above the WGFD management objective of 4,200. The CCPA is located within Hunt Area 21, where the hunter success rate for 1999 was 37.7%.

3.7.3 Upland Game Birds

Greater Sage Grouse. The CCPA is located within the extensive sagebrush/grassland habitat of southcentral Wyoming where greater sage grouse are common inhabitants. Strutting grounds (leks), nesting, brood-rearing, and wintering habitats are all important habitat components required by greater sage grouse. Sometimes these habitats are contiguous and other times occur in a patchy, disconnected pattern (Call and Maser 1985). A high proportion of nesting habitat is usually located within two miles of leks (Call 1974, Braun et al. 1977, Hayden-Wing et al. 1986, Lyon 2000). The greater sage grouse is not formally listed as a threatened, endangered, or sensitive species, however the greater sage grouse receives special consideration because of population declines over much of its range and its importance as an upland game bird in the state of Wyoming.

The CCPA is located within the Sierra Madre upland game management unit area (Area 25). According to the Annual Report of Upland Game and Furbearer Harvest for 1999, 857 greater sage grouse were harvested in Area 25 providing 631 hunter recreation days (WGFD 2000b). The Sierra Madre Upland Game Management Area accounted for approximately 4.0 percent (857 birds out of 21,556) of the state-wide harvest of greater sage grouse in 1998.

Approximately 88% of the CCPA (1,809 AC) is classified as Wyoming big sagebrush habitat, and the remainder is classified as desert shrub (180 acres; 9% of CCPA) and greasewood fans and flats (61 acres; 3% of CCPA). Aerial surveys were conducted by HWA biologists during February 2001 to identify greater sage grouse concentration areas during winter. Winter 2000-2001 was worse than most years and snow cover was extensive and deep. This forced greater sage grouse to seek out habitat with sagebrush tall enough to remain above the snow. Those areas of habitat where greater sage grouse were found during the winter aerial survey were classified as crucial or severe winter relief habitat. Although several areas outside, but within the vicinity of the CCPA, were identified as severe winter relief habitats during the 2000-2001 winter survey, there could be additional areas that qualify but went undetected because they did not have grouse on them during the day the survey was conducted. Additional surveys during severe winters would need to be conducted in order to locate previously undetected severe winter relief habitats. No patches of greater sage grouse crucial winter habitat were located within the CCPA, however 2 patches were located within 1 mile of the pod boundary (Figure 4-1). Aerial surveys were also conducted by HWA biologists in late March and early April, 2001 to check the status of known greater sage grouse leks and document new leks. Linear transects were flown at 1/4 mile spacing intervals at an average altitude of 300 feet using a fixed-wing aircraft. Lek locations were recorded with a handheld GPS receiver. Two active greater sage grouse leks were located within 2 miles of the pod (Figure 4-1). The 2-mile buffer around the 2 leks includes 919 acres (45%) of the CCPA.

Five of the eight proposed wells and/or related facilities are located within the 2-mile buffer areas of the active leks, and it is likely that greater sage grouse nest on the CCPA, given the presence and proximity of the leks to the pod.

3.7.4 Raptors

Raptor species that may occur on the CCPA include golden eagle, bald eagle, northern harrier, sharp-shinned hawk, Cooper's hawk, northern goshawk, red-tailed hawk, Swainson's hawk, rough-legged hawk, ferruginous hawk, American kestrel, merlin, prairie falcon, peregrine falcon, short-eared owl, long-eared owl, great-horned owl, and burrowing owl. Helicopter surveys of raptor nests on and around the CCPA were conducted by HWA biologists during late May 2001. The helicopter survey protocol consisted of flying low-level, ½ mile interval transects within a one mile buffer zone of each pod. Areas of potential raptor nest habitat (cliffs, rock outcrops, etc.) were surveyed more intensively. Nest locations were recorded with a GPS unit. One active ferruginous hawk nest was located approximately 3/4 mile southwest of the CCPA (Figure 4-1). Thirteen inactive ferruginous hawk nests and one unknown raptor nest were located on or within 1 mile of the CCPA (Figure 4-1).

3.7.5 Threatened and Endangered Species

Black-footed Ferret and Associated White-tailed Prairie Dog Colonies. The black-footed ferret's original distribution in North America closely corresponded to that of prairie dogs (Hall and Kelson 1959, Fagerstone 1987). In Wyoming, white-tailed prairie dog (*Cynomys leucurus*) colonies provide habitat for black-footed ferrets. Ferrets depend almost exclusively on prairie dogs for food and they also use prairie dog burrows for shelter, parturition, and raising their young (Fagerstone 1987).

Prairie dog colonies on the CCPA were mapped on the ground during the summers of 2000 and 2001 by HWA. The edges of the prairie dog towns were mapped using a handheld GPS receiver and an ATV. If prairie dog burrows are located within 200 meters of each other they are considered to be in the same town. One prairie dog town (town # 1) occurs within the pod boundary (Figure 4-1). Burrow density in this town is greater than 8 burrows/acre and qualifies the town as suitable black-footed ferret habitat. Given the current location of the proposed development, (roads, wells and pipelines) ferret surveys would not need to be conducted in this prairie dog town since all development would occur outside the town.

Mountain Plover. The mountain plover nests over much of Wyoming, but preferred habitat is limited throughout its range (Oakleaf et al. 1982, Dinsmore 1983, Leachman and Osmundson 1990). This ground-nesting species is typically found in areas of short (less than four inches) vegetation on slopes of less than five percent. Any short grass, very short shrub, or cushion plant community could be considered plover nesting habitat (Parrish et al. 1993), however, mountain plovers prefer shortgrass prairie with open, level or slightly rolling areas dominated by blue grama and buffalograss (Graul 1975, Dinsmore 1981, Dinsmore 1983, Kantrud and Kologiski 1982). Loss of wintering and breeding habitats and prey-base declines from pesticide use are thought to be factors contributing to the decline of mountain plovers on the North American Continent (Wiens and Dyer 1975, Knopf 1994).

Although prairie dog towns usually provide potential habitat for mountain plovers, the town that is

located on the pod is covered with such dense and tall sagebrush that it is very unlikely to be used by plovers. This prairie dog town was surveyed for mountain plovers in May 2001 by HWA biologists and no birds were found (Figure 4-1).

Bald Eagle. Primary bald eagle wintering areas are typically associated with concentrations of food sources along major rivers that remain unfrozen where fish and waterfowl are available, and near ungulate winter ranges that provide carrion (Steenhof et al. 1980). Wintering bald eagles are also known to roost in forests with large, open conifers and snags protected from winds by ridges, often near concentrations of domestic sheep and big game (Anderson and Patterson 1988).

Incidental sightings of bald eagles have been recorded in the vicinity of the CCPA (WGFD 2000c). Most observations were documented between November and March, indicating that the area is commonly used by bald eagles during the winter months. No communal winter roosts are known to exist on or near the CCPA. Inspection of BLM and WGFD raptor nest records, and results of aerial and ground raptor nest surveys conducted by HWA reveal that no bald eagle nests occur within a 2-mile buffer of the CCPA. The closest known nest is located in Section 11, T12N:R93W (Cerovski 2000), approximately 24 miles southwest of the CCPA. This nest has been active each of the last five years.

Canada Lynx. Records of lynx in Wyoming indicate that most lynx or lynx sign between 1973 and 1986 were in lodgepole pine (18%) and spruce-fir (41%) communities (Reeve et al. 1986). According to Reeve et al. (1986), more than 50 percent of lynx records in Wyoming occurred in the northwestern region of the state. The nearest records of lynx to the CCPA were from the Medicine Bow River in 1856 (Reeve et al. 1986). Since then, no lynx sightings or sign have been documented in Carbon County.

Due to the facts that: (1) the CCPA does not include high elevation lodgepole pine/spruce-fir habitat types preferred by this species, (2) the CCPA does not support a population of snowshoe hares (preferred prey item), (3) there are no recorded lynx sightings near the CCPA (WGFD 2000c, WYNDD 2000), and (4) the closest potential habitat is more than ten miles away in the Sierra Madre Mountains, it is unlikely that lynx occur on or near the CCPA.

Threatened and Endangered Fishes and Other Aquatic Species. Four federally endangered fish species may occur as residents of the Little Snake River system downstream from the CCPA: Colorado pikeminnow (Ptychocheilus lucius), bonytail (Gila elegans), humpback chub (Gila cypha), and razorback sucker (Xyrauchen texanus) (FWS 2000a). The last sighting of any of these fish in the Little Snake River was of a single Colorado pikeminnow in 1990. Currently, these fish species are not likely to be found in the mainstem Little Snake River nor its tributaries within the specific project area, and critical habitat for these species has not been designated in Wyoming (Upper Colorado River Endangered Fish Recovery Program 1999), however, the potential for project-related impacts to these tributaries in the Colorado River system warrant their inclusion in this NEPA document. The lack of perennial waters within the CCPA and for several miles downstream probably precludes potential for the occurrence of the four species of endangered fish endemic to the Little Snake River watershed. Although highly unlikely, any of these fish species may potentially occur in Muddy Creek or farther downstream in the Little Snake River or Yampa River on a seasonal basis for spawning and/or rearing. Currently, it is not known whether suitable spawning, age-0, or juvenile habitat for any of these species may still be present in the waters downstream from the CCPA. To date however, critical habitat for these fish species has not been

designated anywhere in Wyoming (Upper Colorado River Endangered Fish Recovery Program 1999).

Four species of fish from the Colorado River Basin have been listed as threatened or endangered. The Colorado pikeminnow, bonytail, and humpback chub are all members of the minnow family. The razorback sucker is a member of the sucker family. All four of these fish species share similar habitat requirements and historically occupied the same river systems. Declines in their populations are mainly attributed to impacts of water development on natural temperature and flow regimes, creation of migration barriers, habitat fragmentation, the introduction of competitive and predatory non-native fishes, and the loss of inundated bottom lands and backwater areas (Minckley and Deacon 1991, FWS 1993). One adult Colorado Pikeminnow was collected from the Little Snake River in Carbon County, Wyoming in 1990. Subsequent survey attempts by WGFD personnel failed to yield any other specimens of Colorado pikeminnow from this area of the Little Snake River (Baxter and Stone 1995). Neither the bonytail, nor humpback chub has ever been reported within waters of the project area or immediately downstream from this project area. Suitable habitat for razorback sucker is not believed to be available on the project area and the species is not known from the Little Snake River drainage. Although unlikely, both Muddy Creek and the Little Snake River may have the potential to support these species of fish at certain times.

Currently, there are no threatened or endangered amphibian species that are known to occur in this portion of Wyoming.

3.7.6 Species of Concern - Wildlife, Fish, and Other Aquatic Species

Wildlife Species of Concern. Species of concern includes candidates for federal listing under the ESA, BLM special status species, FS sensitive species, WGFD special concern species, and species that are designated rare by The Nature Conservancy and WYNDD. Species which are not listed as endangered or threatened by the FWS, but have been identified for possible listing in the future, are classified as candidate species. Nine wildlife species of concern may occur on or near the CCPA. The wildlife species include Wyoming pocket gopher (*Thomomys clusius*), swift fox (*Vulpes velox*), smooth green snake (*Liochlorophis vemalis*) northern goshawk (*Accipiter gentilis*), burrowing owl (*Athene cunicularia*), Columbian sharp-tailed grouse (*Tympanuchus phasianellus*), snowy plover (*Charadrius alexandria*), white-faced ibis (*Plegadis chihi*), long-billed curlew (*Numenius americanus*), Brewer's sparrow (*Spizella breweri*), and sage sparrow (*Amphispiza belli*). These species and their sensitivity status/rank are listed in Appendix D.

One perennial water body occurs on the permit area (LSRCD reservoir) that may receive use by waterfowl. It results from waters recovered during hydrocarbon development in the area. This impoundment is located in the NW ¼ of Section 13, T16N:R92W, has 15.8 surface acres and was first impounded in 1997. The recent impoundment of the LSRCD reservoir has provided limited time for the establishment of an emergent vegetation complex in association with this reservoir. Due to the limited open water habitat and absence of perennial streams, waterfowl and shorebird use of the project area is minimal.

Fish Species of Concern. Fish species that are not listed as endangered or threatened by the FWS, but have been identified for possible listing in the future have been included as species of concern. In addition, other species considered sensitive to human development have been included in this list. An ephemeral and locally intermittent stream drains the CCPA and is an

unnamed tributary to Dry Cow Creek. Dry Cow Creek drains into Cow Creek several miles downstream from the project area. Cow Creek is generally an intermittent stream with localized areas of perennial water. All of the drainages within the CCPA are Class 5 (WGFD 1991) ephemeral drainages. Although the majority of streams on the CCPA do not have the potential to support fish species of concern on a year-round basis, studies indicate that these species may ascend ephemeral tributary streams to spawn (USFWS 1985, Maddux and Kepner 1988, Weiss et al. 1998). Thus, the ephemeral drainages fed by runoff from the project area may provide habitat for fish on a seasonal basis. Fish species of concern are known to occur in waters downstream from the CCPA, and it is possible that Dry Cow Creek and/or its tributaries within the project area may be utilized seasonally for spawning and/or rearing habitats.

Four fish species of concern are known to occur downstream from the project area: roundtail chub (*Gila robusta*), bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), and Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) (WYNDD 2000). One game-fish, the Colorado River cutthroat trout generally occurs much farther downstream from the project area in the Little Snake River (Baxter and Stone 1995). This species has been petitioned for listing as threatened or endangered. The three non-game fish species can be found within Muddy Creek, approximately seven miles downstream from the project area.

One reservoir currently exist within the project area and is fed by waters recovered from hydrocarbon wells drilled at upstream locations. This reservoir was constructed by the LSRCD, BLM, and WGFD in 1997 to supply water for livestock and wildlife use by impounding water discharged from the Double Eagle 1X-12 well. Although this reservoir has been stocked for use as a recreational fisheries in the past, it is not currently known to support a sport fishery.

Other Aquatic Species of Concern. The wide variety of vegetation types and habitats occurring within the greater Atlantic Rim project area supports a diverse fauna including a relatively large number of non-listed amphibian species. Of the amphibian species that occur in Wyoming, six potentially occur within the CCPA. These species include five frogs and toads, and one salamander. Four of these species are species of concern (WYNDD 2001): the northern leopard frog (*Rana pipiens*), Great Basin spadefoot (*Scaphiopus intermontanus*), boreal toad (*Bufo boreas boreas*), and Columbia spotted frog (*Rana pretiosa*). Northern leopard frogs have been documented in all counties of Wyoming and this species has a high probability of occurring in any areas of the CCPA having perennial water (WGFD 2000 and 2001, WYNDD 2001). The Great Basin spadefoot is little known in Wyoming (Baxter and Stone 1992), although it has the potential to occur throughout the CCPA. One Great Basin spadefoot was reported in the WOS (WGFD 2000) several miles southwest of the project boundary and the Wyoming Species Atlas (WGFD 1999b) indicates the species' range encompasses the project area. Boreal toads are generally restricted to relatively moist conditions although their range is thought to encompass the Muddy Creek watershed located just west of the project area (Baxter and Stone 1992). The Wyoming Species Atlas (WGFD 1999b) and WYNDD (2001) indicate sightings within both Sweetwater and Carbon counties, although no sightings of this species are reported within six miles of the greater Atlantic Rim project area boundary in the WOS (WGFD 2000 and 2001). In Wyoming, Columbia spotted frogs have been documented in the northwest corner of the state (Baxter and Stone 1992), however none have been found within a six mile perimeter of the project area (WGFD 2000 and 2001, WYNDD 2001) and it is unlikely that suitable habitat for this species occurs on the project area. These species and their sensitivity status and rank are listed in Appendix D. The WGFDs' Strategic Plan (1978) identifies the need to maintain populations of amphibians and reptiles in their natural habitats throughout Wyoming, since the number of amphibian species found in Wyoming

is quite limited due to geography and climate (Baxter and Stone 1992).

3.8 RECREATION

Recreation resources in the CCPA are typical of those found in the Red Desert Region of Wyoming. Recreation use of BLM and private lands within the CCPA are best characterized as dispersed; there are no developed recreation sites or facilities. Most recreation activities occur during the fall hunting seasons. The area attracts small game hunters in September and October during the greater sage grouse season. Pronghorn hunting also occurs in September. Other hunting use occurs during the mule deer season in mid to late October and hunting for rabbits and predators later in the fall and winter. During other seasons, the area attracts small numbers of recreationists engaged in rock collecting, camping and hiking, wild horse and wildlife observation, outdoor photography and picnicking. The area also has a limited amount of use by off-road vehicle enthusiasts. Although data on recreational visitation are not available, overall use levels are generally low (BLM 2000). Low visitation is a function of the small number of local residents, long drives from major population centers, lack of publicized natural attractions, and road conditions that limit vehicle access into many back country areas.

3.9 VISUAL RESOURCES

The CCPA is typical of the more rugged sections of Wyoming Red Desert Region. The characteristic landscape is moderately undulating with occasional areas of steep topography (badland breaks and buttes) which stand out as contrasting forms across most of the rest of the area. Numerous small drainages dissect the landscape adding diversity. The combination of topography, buttes and badland breaks subdivide the area into a number of small viewsheds. Larger views that encompass several viewsheds are available from high points. The sky/land interface is a significant aspect of all distant views. The predominant vegetation, typical of cold desert steppe, is alkali and low sage brush, mixed desert scrub, grasses and forbs with scattered patches of big sage/rabbit brush on flatter north and east facing slopes, along drainage ways and in large depressions. Small established stands of juniper exist within the study area. The combination of plant communities creates a subtle mosaic of textures and colors. Predominant vegetation colors in early spring are green and gray green changing to gray green and buff/ochre as grasses and forbs cure in the summer and fall. Reddish brown and buff colors of the badland formations add contrast and dominate in areas of steep topography. Evidence of cultural modification in the CCPA include improved and unimproved roads, power lines and some oil and gas production facilities. Motorists traveling Wyoming Highway 789 would not have visual access, or limited access, to the CCPA because of viewing distance (3 to 6 miles) and intervening elevated topography. However, facilities and activities located on ridge lines or buttes are visible over longer viewing distances. The area receives moderate use by recreationists including big and small game hunters, rock collectors, wild horse and wildlife watchers, backpackers and ATV operators. The quality of the visual resource is an important part of the recreational experience for many of these

users. Other non-recreational users of the area, including grazing permit holders and those working in the oil and gas industry, would also be affected by changes to the visual resources.

The intent of the BLM VRM program is to preserve scenic values in concert with resource

development. BLM personnel responsible for visual resource management have classified the CCPA as Class 3. The VRM describes the levels of change to the visual resource permitted in Class 3 landscapes as:

> Class 3: *Contrasts to the basic elements caused by a management activity are evident but should remain subordinate to the existing landscape.*

Thus, for projects in Class 3 areas, project facilities, activities and site disturbance that contrast enough to attract viewer attention and are evident in the landscape are allowed, but they should be constructed in a manner that reflects the lines, forms, colors and textures of the characteristic landscape.

3.10 CULTURAL RESOURCES

3.10.1 Culture Chronology of the Project Area

Archaeological investigations in the Washakie Basin indicate the area has been inhabited by prehistoric people for at least 10,000 years from Paleoindian occupation to the present. The accepted cultural chronology of the Washakie Basin is based on a model for the Wyoming Basin by Metcalf (1987) and revised by Thompson and Pastor (1995). The Wyoming Basin prehistoric chronology is documented in Table 3-10.

Table 3-10. Prehistoric Chronology of the Wyoming Basin.

Period	Phase	Age (B.P.)
Paleoindian		12,000 - 8500
Early Archaic	Great Divide	8500 - 6500
	Opal	6500 - 4300
Late Archaic	Pine Spring	4300 - 2800
	Deadman Wash	2800-2000/1800
Late Prehistoric	Uinta	2000/1800 - 650
	Firehole	650 - 300/250
Protohistoric		300/250 - 150

from Metcalf (1987), as modified by Thompson and Pastor (1995)

Historic use of the area is limited by the formidable topographic relief. Steep canyons, inadequate water supply, badlands, and escarpments make the area inhospitable for settlement with only limited ranching activities present. Previously recorded historic sites are represented by a ranching/stock herding site, three historic debris sites, one historic cairn, and the Rawlins-Baggs stage road.

3.10.2 Excavation Data

No sites have been extensively tested or excavated in the CCPA. However, several excavations have been conducted in the surrounding area contributing data about the prehistory and history of the area.

The Sheehan site is a multi-component prehistoric site (Bower et al.1984) located in the Washakie Basin, east of the analysis area. Component I dates to the Archaic period and Component II dates to the Late Prehistoric period. Data suggests both components reflect short-term winter camps with meat processing activities identified and locally available lithic materials exploited. The Yarmony site in northwest Colorado contained a housepit dating to ca. 6300 B.P. (Metcalf and Black 1991). The Early Archaic period housepit is a large, semi-subterranean, two-room dwelling containing four slab-lined storage bins, interior hearths and other floor features and is postulated as a long-term winter base camp. The Nova Site (48CR4419) is located ca. 4 miles north of the CCPA block. The site is a Uinta phase housepit dating from 1098 to 1285 B.P. represents Component I as a short-term spring/late summer occupation. Component II was not dated but is believed to occur as the reuse of the Component I housepit.

3.10.3 Summary

Block cultural surveys were conducted by John Albanese of Casper, Wyoming on eight(8) proposed wellsites, access roads and one reservoir site of the CCPA. These cultural surveys have been submitted to the BLM in Rawlins Wyoming. A total of eight(8) sites were located and inventoried on these surveys. Seven(7) of the sites were identified as historic stock herder camps, none considered significant. One prehistoric site, identified in an earlier survey, was noted but considered as non significant by Albanese.

3.11 SOCIOECONOMICS

The primary geographic area of analysis for potential socioeconomic effects of the Proposed and No Action alternatives is Carbon County, Wyoming and the communities of Baggs, Dixon and Rawlins. Temporary housing availability is also described for the Moffat County, Colorado community of Craig, and the Sweetwater County, Wyoming community of Wamsutter. Carbon County socioeconomic conditions characterized for the assessment include economic and population conditions, temporary housing resources, law enforcement and emergency management services, certain local and state government revenues and local attitudes and opinions.

3.11.1 Economic Conditions

Carbon County has a natural-resource-based economy. Basic economic sectors, which bring revenues into the county, include oil and gas production and processing, coal mining, electric power generation, agriculture (primarily ranching and logging), some manufacturing and transportation (primarily the Union Pacific railroad).Those portions of the retail and service sectors which serve travelers and tourism and recreation visitors are also basic. Employment and earnings are two common measures of economic activity. The mining sector, which includes oil and gas employment, would be the primary sector affected by the Proposed and No Action alternatives.

In 1998 Cabon County employment totaled 9,780 full and part-time jobs, which was about one

percent lower than the 1990 level (WDAI 2000a) and about 28 percent lower than the1980 level of 13,560 jobs. Mining sector employment, which includes oi and gas jobs, decreased 46 percent from 1990 to 1998, from 934 to 501 jobs. The 1998 level was 86 percent lower than the 1980 level of 3,563 jobs mining jobs (UW 1997). The mining sector losses and the volatility in total employment are attributed to the shutdown of the Rosebud and Seminoe # 2 mines (USDI-BLM 1999) and more recently the RAG Shoshone mine near Hanna (Rawlins Daily Times 2000a). Other mine workforce reductions and the delay in opening of an anticipated mine have further affected mining sector employment in the county, however, increased natural gas drilling has resulted in increases in oil and gas employment in recent years (Schnal 2000).

In Carbon County, ten-year unemployment rates ranged from a low of 5.2 (1997) to a high of 6.1 (1993). The 1999 Carbon County unemployment rate was 5.3, based on 446 unemployed persons out of a total labor force of 8,475 (Wyoming Department of Employment 2000).

Carbon County earnings increased from $202 million to $211 million between 1990 and 1998, a 5 percent increase. However, when adjusted for inflation, Carbon County earnings decreased by 21 percent from their 1990 level during the eight-year period.

3.11.1.1 Oil and Gas Activity

Carbon County natural gas production increased, from 76 million MCF in 1995 to about 80 million MCF during 1999. Carbon County oil production in 1999 was within 0.2 percent of the 1995 level of 1.3 million barrels.

One indicator of future production, approved APD's, increased steadily in Carbon County in recent years, from 50 in 1995 to 127 in 1999. Increased drilling may result in increased production in the county if drilling efforts are successful and commodity prices increase or stabilize at economic levels. During 1999, there were a total of 742 producing oil and gas wells in Carbon County (WOGCC 1995-1999).

3.11.1.2 Economic Activities in the Vicinity of the Proposed Action

Other economic activities occurring on and near the CCPA include oil and gas exploration (Vosika Neuman 2000), cattle grazing (Warren 2000) and outdoor recreation activities such as hunting (pronghorn antelope, mule deer, elk and upland birds), hiking, off road vehicle use, camping and sightseeing. Currently 35 commercial hunting outfitters hold permits for the hunt areas where the CCPA is located, although the project area comprises only a small portion of these hunt areas (Clair 2000).

3.11.2 Population

Carbon County population growth and decline parallels the employment boom and bust cycle outlined at the beginning of this section. For example, the 2000 Carbon County population (15,639) was 29 percent lower than its 1980 level of 21,896 (WDAI 2001). Between 1990 and 2000, the City of Rawlins, the largest community in Carbon County, lost an estimated 842 persons to end the period at 8,538, although the city is growing as a result if the opening of a new state prison facility. The Town of Baggs gained 76 residents, or 28 percent of its 1990 population, and the Town of Dixon, several miles east of Baggs, gained 12 persons to end the period with an estimated

population of 79.

3.11.3 Temporary Housing Resources

The nature of CBM drilling and field development activities (relatively short duration tasks performed primarily by contractors) results in demand for temporary housing resources such as motel rooms and mobile home and recreational vehicle (RV) spaces near the project area.

3.11.3.1 Baggs/Dixon Area

In the Baggs/Dixon area, most temporary housing resources are fully occupied by oil and gas workers during the summer; during winter more units become vacant. A 26-space mobile home park in Baggs is equipped to accommodate RV's as well as mobile homes. Within the park there are several rental mobile homes. There is a small four-space mobile home park in Savery and a number of mobile home lots scattered throughout the Little Snake River Valley (Grieve 2000).

There are two motels in Baggs with a total of 64 rooms, most of which can accommodate several guests. Both motels routinely accommodate oil and gas industry workers as well as tourists, travelers and hunters. As with mobile home parks, the motels are filled to capacity during the summer and fall and partially vacant during the winter. Most oil and gas occupants are relatively short term in nature, moving in and out of the community as work assignments are completed (Willis 2000, Hawkins 2000). Longer-term rental housing in the Baggs/Dixon area consists primarily of an apartment building and a newly constructed rental duplex which was vacant in the spring of 2001.

3.11.3.2 Craig, Colorado

The Craig Chamber of Commerce lists 12 motels with a total of 467 rooms and 2 campground/RV parks with a total of 128 spaces (Craig Chamber of Commerce 2000).

3.11.3.3 Wamsutter

There are temporary housing resources are available in the Town of Wamsutter (Carnes 2000). Including several mobile home parks and two motels, the Town is at the center of a 200 well per year BP drilling and field development program. Wamsutter town officials recently stated that there no available housing in the town to accommodate workers and their families associated with the current drilling and field development activity (Rock Springs Rocket Miner 2001)

3.11.3.4 Rawlins

Rawlins has 19 motels and 4 RV parks (Hiatt 2000). There are also a substantial number of apartment buildings with some availability (Hewitt 2000, Rawlins Daily Times 2000b).

3.11.4. Law Enforcement and Emergency Response

Law enforcement services in the southwestern portion of the county are provided by the Carbon County Sheriff's Department. Currently coverage is provided by one full-time and one part-time deputy. The deputies provide coverage for the Town of Dixon and the community of Savery; the

Town of Baggs has one police officer (Colson 2000).

Medical services in Baggs are provided by the county-owned clinic, which is staffed by a physician's assistant (PA), supported by other medical and administrative personnel. Emergency response is provided by six volunteer emergency medical technicians (EMT) who staff two county-owned ambulances. Seriously injured patients are transported to Craig or Rawlins, depending on the location of the accident. Casper-based Flight-for-Life is also available if appropriate (Herold 2000).

3.11.5 Local Government and State Government Revenues

Local and state government fiscal conditions most likely to be affected by the proposed action and No Action alternatives include county, school and special district ad valorem property tax revenues, state, county and municipal sales and use tax revenues, state severance taxes, and federal mineral royalty distributions. Some county, municipal and special district service expenditures may also be minimally affected.

3.11.5.1 Ad Valorem Property Tax

Carbon County assessed valuation in fiscal year (FY) 2000 totaled about $337 million, which yielded total property tax revenues of $21.3 million. Total mill levies within Carbon County communities ranged from 65 to 75.3. FY 2000 assessed valuation from 1999 natural gas production totaled $159 million or about 47 percent of total assessed valuation. Assessed valuation from oil production totaled 16.9 million or about 5 percent of total valuation (WTA 2000).

3.11.5.2 Sales and Use Tax

FY 2000 sales and use tax collections in Carbon County totaled about $21 million. These include collections from a four percent statewide sales and use tax, a one-percent general purpose local-option sales and use tax and a one-percent specific-purpose local option sales and use tax, which is anticipated to expire in the summer of 2001 (WDAI 2000b).

3.11.5.3 Severance Taxes

In Wyoming, severance taxes are levied against certain minerals produced in the state, including a six percent severance tax on natural gas. In FY 2000, severance tax distributions totaled $275 million (WDAI 2000c). Of the total, 44 percent was attributable to severance taxes on natural gas.

3.11.5.4 Federal Mineral Royalty Distributions

The federal government collects a 12.5 percent royalty on oil and natural gas extracted from federal lands. Fifty percent of those royalties are returned to the state where the production occurred. In Wyoming, the state's share is distributed to a variety of accounts, including the University, School Foundation fund, Highway fund, Legislative Royalty Impact Account, and cities, towns and counties. In FY 2000, a total of $309 million in federal mineral royalty funds were distributed to Wyoming entities (WDAI 2000d)

3.11.6 Attitudes and Opinions

A 1996 survey conducted in conjunction with the preparation of the Carbon County Land Use Plan provides some insight into resident attitudes and opinions regarding land use, oil and gas development, natural resource conservation and use and other topics. Just over 300 residents completed the survey, yielding an estimated statistical reliability of about 95 percent (Pederson Planning Consultants 1998).

Water resource conservation and concern for government regulation of land use were the most frequently listed important land use issues, followed closely by the availability of water to support future land uses, the economic viability of ranching, timber and oil and gas industries, and the need to conserve wildlife habitat.

County-wide, 54.9 percent of survey respondents (based on a weighted average; some respondents indicated more than one response) indicated that conservation of land, water and wildlife resources was more important than increased oil and gas production, while 36.9 percent indicated that increased oil and gas production was more important. However, among Baggs respondents, the reverse was true. About 54 percent indicated that increased oil and gas production was more important than conservation of land, water and wild life resources while 36 percent indicated that resource conservation was more important. The land use plan attributes this difference to Baggs' greater economic dependence on future oil and gas employment.

Concerning management of federal lands, the largest number of respondents (69.5 percent) indicated that more federal lands within the county should be designated for the purpose of conserving fish and wildlife habitat and surface and groundwater resources. In addition, 60.8 percent of respondents indicated that more land should be designated for public recreation, 48.8 percent indicated more land should be leased for oil and gas industry exploration and production, 48.7 percent indicated more land should be leased for commercial mining, and 44.5 percent indicated more land should be made available to local timber companies for commercial timber harvest.

Coal-bed methane development was not considered during the survey, therefore resident attitudes and opinions about unique aspects of CBM are not known (Hewitt 2000).

3.11.7 Environmental Justice

Executive Order (EO) 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations" was published in the *Federal Register* (59 FR 7629 on February 11, 1994). EO 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations (defined as those living below the poverty level). The EO makes clear that its provisions apply fully to American Indian populations and Indian tribes, specifically to affects on tribal lands, treaty rights, trust responsibilities, and the health and environment of Indian communities.

Communities within Carbon County, entities with interests in the area, and individuals with ties to the area all may have concerns about the presence of a CBM within the project area. Communities potentially impacted by the presence or absence of the proposed development have been identified above in this section. Environmental Justice concerns are usually directly associated with impacts on the natural and physical environment but these impacts are likely to be interrelated to social and

economic impacts as well.

Native American access to cultural and religious sites may fall under the umbrella of environmental justice concerns if the sites are on tribal lands or access to a specific location has been granted by treaty right. With regard to environmental justice issues affecting Native American tribes or groups, the project area contains no tribal lands or Indian communities, and no treaty rights or Indian trust resources are known to exist for this area.

3.12 TRANSPORTATION

The regional transportation system serving the project area includes an established system of interstate and state highways and county roads. Local traffic on federal land is served by improved and unimproved BLM roads.

3.12.1 Access to the Project Site

Access to the project site is provide by a combination of Interstate, state highways, and county and BLM roads. Table 3-11 displays specific access routes to the CCPA. The Wyoming Department of Transportation (WYDOT) measures average daily traffic (ADT) on federal and state highways. ADT on highways providing access to the CCPA are shown in Table 3-11.

Table 3-11. Access Routes to the Cow Creek Pod Project Area.

Highway or Road		
Highway or Road	ADT	Level of Service / Accidents
I-80	Rawlins - Wamsutter: 10,670 (6,170 trucks)	A 1999: 89 5 yr average: 112.4
SH 789	(1) @ I80/ Crestone Junction: 850 (160 trucks); (2) @ Baggs Corporate Limit: 1650 (190 trucks)	B 1999: 27 5 yr average 16.4
CCR 608 (Wild Cow Road)	n/a	n/a

Sources: Wyoming Department of Transportation, Carbon County Road and Bridge Department

WYDOT assigns levels of service to highways in the state system. Levels of service (A through F) are assigned based on qualitative measures (speed, travel time, freedom to maneuver, traffic interruptions, comfort and convenience) that characterize operational conditions within traffic streams and the perceptions of those conditions by motorists. A represents the best travel conditions and F represents the worst. Levels of service for highways providing access to the CCPA are also shown in Table 3-11.

Access to the CCPA is provided by the two-lane paved Wyoming State Highway 789 (SH 789) from

Interstate 80 (I-80) at Creston Junction south towards Baggs, Wyoming, or north from Baggs, Wyoming. Access to the CCPA is by SH 789 north from Baggs for approximately 22 miles to the intersection with Carbon County Road 608 ("Dad Road"). The distance from SH 789 to the CCPA is approximately 3 miles. CCR 608 is a two-lane improved and unimproved native material road, and currently provides access to oil and gas fields in the area (Evans 2000).

3.13 HEALTH AND SAFETY

Existing health and safety concerns in and adjacent to the CCPA include occupational hazards associated with CBM exploration and operations; risk associated with vehicular travel on improved and unimproved county and BLM roads; firearms accidents during hunting season and by casual firearms use such as plinking and target shooting; and low probability events such as land slides, flash floods and range fires.

3.14 NOISE

Other than vehicle traffic on Wyoming State Highway 789; jet aircraft overflights at high altitudes; and localized vehicular traffic on county, BLM and two-track roads in the project area; only on-going drilling and production operations on lands adjacent to the project area create even modest sound disturbances within, and in the immediate vicinity of, the CCPA.